

BIOLOGY

Paper 5090/01
Multiple Choice

| <i>Question Number</i> | <i>Key</i> | <i>Question Number</i> | <i>Key</i> |
|------------------------|------------|------------------------|------------|
| 1 | C | 21 | D |
| 2 | A | 22 | A |
| 3 | B | 23 | B |
| 4 | B | 24 | B |
| 5 | B | 25 | D |
| 6 | C | 26 | A |
| 7 | A | 27 | B |
| 8 | D | 28 | D |
| 9 | B | 29 | D |
| 10 | A | 30 | C |
| 11 | D | 31 | B |
| 12 | C | 32 | C |
| 13 | B | 33 | B |
| 14 | C | 34 | A |
| 15 | D | 35 | B |
| 16 | C | 36 | D |
| 17 | C | 37 | C |
| 18 | D | 38 | C |
| 19 | C | 39 | A |
| 20 | C | 40 | D |

General

This paper spread the candidates well. Questions based upon knowledge were well answered, while those requiring reasoning caused more problems. Candidates knew more about the metabolism of nitrogen, which has previously been a blank spot. Every report includes the vital instruction to “read the question”. The most obvious errors occurred in **Question 10** and especially in **Question 40**, in which many candidates missed the last word and answered the wrong question.

Comments on specific questions

Questions 1 5 6 9 12 13 15 17 18 21 22 30 31 34 35 36 37 and 39 proved to be easy.

2 Glucose absorption may be by diffusion at first, but to absorb all the glucose from the gut requires an active mechanism. Both B and C are diffusion; D is evaporation.

- 3 Where a graph line crosses an axis is usually significant. When no change in length occurs, the external concentration must be close to that of the potato cells.
- 4 The stem states that the protease is found in the stomach, so an acidic solution will be most effective, although option A will also have some activity.
- 7 The stem refers to "full sunlight". The question refers to "normal CO₂ concentrations", which are of the order of 0.04%. Over this range the line is a straight relationship between photosynthetic rate and CO₂ concentration. Option C would be correct at higher CO₂ concentrations
- 8 The symptoms are of scurvy. A refers to anaemia, B and C to rickets.
- 10 Statements one and two are correct. Saliva does not emulsify fats, but the mistake that made the question difficult was misreading statement four. Teeth do not break molecules, nor change insoluble ones into soluble ones.
- 11 Option A would reduce ion uptake. In C, the movement of water does not affect ion uptake.
- 14 A version of Harvey's classic demonstration. The bandage at Z allows arterial blood into the forearm, but reduces the flow in surface veins. With the finger at W, squeezing the blood along the vein to will empty the vein and the valve at Y stops any more blood entering the vein.
- 16 Option B was popular, but nerves use lots of energy. Diffusion is passive (option C).
- 19 Option B was popular, but it is only true if the man is lifting the bars, while standing on the ground. The stem refers to the "dipped position", and the diagram clearly shows him with his legs hanging down in the air, not supporting him.
- 20 Some popular misconceptions here. Option A refers to secretion as does the release of sweat. Evaporation of sweat is the process leading to the loss of heat. Sweating does release tiny, but not significant amounts of urea. Defecation loses material that is already outside the cells of the body although tiny amounts of ex-haemoglobin are lost from the liver into the gut.
- 23 In a reflex action, the brain receives the information that has caused the response, but only after the reaction has occurred, so the response is initiated from the spinal cord. It seems that this topic is not well understood, since both A and D were popular, but the best candidates did chose B.
- 24 Label A is the ligaments which suspend the lens and are not muscular. D is muscle, but the iris muscles control the amount of light entering the eye and are not concerned with focusing.
- 25 Option C suggests that the substance stops the bacteria numbers from increasing, but in D the numbers fall.
- 26 No stirrer is shown in the diagram. The air entering at the bottom mixes the culture very effectively. Option C was far too popular. This topic is not well known.
- 27 Bacteria are effective decomposers, so B must be the key.
- 28 Option A was popular. Producers make carbohydrates and do not receive them from decomposers, although their respiration will release water which the producers will use in photosynthesis.
- 29 The pyramid is of numbers. Since there are not many Ds, which are the producers, they must be big, as they provide the food for the large number of Cs, which must be small individuals.
- 32 Acid rain is largely due to oxides of sulphur.
- 33 P and Q are haploid gametes. R is the diploid zygote. Although there are four haploid gametes produced, they each have half, not a quarter of the diploid chromosome number.
- 38 Phenotypes refer to the appearance of the individuals, so although the genotype ratio is 1 : 2 : 1, three out of the four possible genotypes are the dominant phenotype,

40 After **Question 38**, this should have been easy. Although the probability of recessive genotypes is 0.25, all of them must be homozygous, so their probability is 1.00.

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Paper 5090/02

Theory

General comments

Some particularly impressive work was seen from several Centres, but a noticeable feature was the more common than usual tendency to mis-read a question. This was all the more surprising when the most regular example of this was to talk about why smoking is now regarded as 'socially acceptable', rather than 'socially unacceptable' as stated in the question.

Comments on specific questions

Question 1

- (a) 'Sepal' was usually correctly stated, though 'petal' was the most common error
- (b) The vast majority opted correctly for **A** as the male flower, with almost all going on to mention the presence of a specific male structure (or the absence of a specific female one).
- (c) (i) "The" method of pollination could only have been insect-pollination, since, of a choice between self- and cross-, both are equally possible. Most candidates appreciated this fact, but only the better ones went on to describe two appropriate features visible on the diagram. Several produced answers such as 'colour' and 'nectar', which belonged in part (ii).
 - (ii) 'Nectar', 'colour' and 'scent' were regularly seen, but so, too and incorrectly, were 'receptacle, ovary 'ovule' (-and 'nectar guides', if rather less so).
- (d) This part was often well-answered. Weaker answers sometimes referred, somewhat mystifyingly, to asexual reproduction. References to genes or alleles were rare.

Question 2

- (a) Reference was sometimes made here to a 'thin cell wall', but, usually, either the elongated nature of the structures or their large surface area was mentioned.
- (b) Some thought that the villus was a microvillus, but this part regularly scored highly.
- (c) (i) Confusion was exposed here, with a significant number of candidates drawing structures such as xylem vessels, or complete vascular bundles, within the root hair cell. Others drew hairy extensions around the perimeter of the cell, and many completely labelled the cell rather than label one structure as instructed. Label lines often ended just short of the intended structure, thus indicating a different structure entirely. Several drew mitochondria which, at this magnification, would not be visible.
 - (ii) Many gave a full description of the functions of a root hair cell without tying their descriptions to any labelled structure. The most popular correct answers referred to the cell membrane and vacuole.

Question 3

This question sought to do no more than probe the candidates' knowledge of transpiration and the need for care and precision before interpreting results. Unfortunately, seeing something fixed to a leaf led many to believe that this was a question of the effect of light, sometimes on transpiration, sometimes on photosynthesis.

- (a) (i) Commonly, answers simply repeated the information provided by the data – that the paper turns pink faster on the lower surface. A number were confused even then and gave the reverse answer.
- (ii) The presence and the function of stomata were often described, but the presence of the cuticle and its waterproof nature was less often referred to.
- (b) There were references to the paper or the leaf not being dry, or to valid 'operator-errors' (though the phrase was often used with no specified examples). Damage to the leaf was rarely mentioned.
- (c) Even those who failed to understand the thrust of the question were often aware that experiments need to be repeated and averages taken, and scored accordingly. Errors included the suggestion that different types of leaf should be used.
- (d) Many failed to explain *how* the student would do the experiment – simply stating the expected result. Some mention of practical procedure and a reference to time were expected.

Question 4

- (a) Apart from the occasional reference to a mineral ion and to oxygen, this part was usually answered accurately.
- (b) Despite the question saying that the Petri dish contained the optimum concentration of nutrients, many suggested adding more. Also, more enzymes were often added, apparently in the belief that that the microorganisms would not produce sufficient enzymes for their needs. However, the necessity of an optimum temperature and pH for enzyme activity was a well-understood requirement (though it was common to suggest that the pH should be 7).
- (c) The only major error here was to believe that the organism might be a virus.
- (d) Candidates were, on the whole, well-drilled in the correct use of antibiotics.

Question 5

- (a) Identification of the oesophagus caused few problems, though there was a good deal more uncertainty over the duodenum which was sometimes thought to be the ileum or even the rectum. Use of the term jejunum was a case of too much knowledge leading to confusion.
- (b) Several believed there would be less starch at **M** than at **N** rather than almost the same amount. Fewer than might have been expected chose the correct option for protein, though most realised that the amount of fibre would be much the same.
- (c) (i) A significant number spoke of protein being absorbed without first being digested.
- (ii) There were varied answers here, with small intestine being a common error. Few named cellulose or lignin, but the majority mentioned that fibre cannot be digested.

Section B

Question 6

- (a) Although there were some excellent answers, there was a tendency to omit detail when describing the two cycles. Reference to carbohydrates being made during photosynthesis was relatively rare, as was mention of the absorption of nitrates by plants for protein manufacture. Mention of urea was surprisingly uncommon as was any reference to combustion occurring in the factory. Nitrification, nitrogen fixation and denitrification were regularly confused.
- (b) CFCs were commonly mentioned, but were not considered to be a particularly likely form of harmful gas released by the factory. Standard examples were regularly offered and were credited accordingly.

Question 7

- (a) A significant number did not relate their answers to the circulatory system, and of those who did, an unqualified reference to muscle was not thought adequate (e.g. heart or artery wall was required).
- (b) Some excellent answers were seen, but it was clear that the names of the blood vessels and the organs they link cause a great deal of confusion. The 'hepatic portal artery' was a common suggestion for one of the vessels as were the pulmonary and renal artery and vein. Even when the correct term was used, the blood vessel's distribution was often inaccurately described. However, despite the confusion, candidates were able to explain some valid differences between blood entering and leaving the liver, though a significant number also gave much irrelevant detail on liver function.

Question 8E

- (a) It was very pleasing to see so many who had accurately learnt the syllabus definition of a drug, though a few seemed to feel that drugs are only medically prescribed substances.
- (b) Descriptions of the effects of alcohol and heroin were common, but only the better candidates explained the effects as required. There was evidence of muddled learning from the fairly large number of candidates who gave almost identical answers for both alcohol and heroin. It should be stressed to candidates that neither heroin, nor the sharing of needles causes AIDS.

Question 8O

- (a) A comforting number knew precisely what harmful effects are caused by each of the major chemical constituents of cigarette smoke. Others gave a long and somewhat speculative list of conditions which often included inaccuracies such as tar being deposited in blood vessels. Many, however, were able to score highly on this section.
- (b) Those who read this as 'socially acceptable' suffered in consequence. Although many knew of the dangers of passive smoking, it was disappointingly rare to see the term explained. It was felt that there should be a mention of inhaling smoke and the consequences of so doing, rather than just a mention of risks being present when in the company of a smoker.

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Paper 5090/03

Practical Test

General comments

Candidates continue to lose marks quite unnecessarily by not following the instructions set out in the questions, for instance by completely omitting labels when instructed to produce a labelled drawing.

Designing an experiment proved difficult for many. Although they had an idea of what was required it was not followed through on the basis of practical instruction, recording and presenting the results that might have been obtained. It should have been possible to do this along the lines of their own practical experience.

Comments on specific questions

Question 1

The temperature of the water that was supplied for use in the plastic bottles varied considerably and many candidates did not make the adjustment to a uniform starting temperature. Perhaps because of this two separate tables were often constructed in **section (a) (i)** rather than the single table that was envisaged.

- (a) (i)** A neat, fully ruled table with three columns was looked for but when two tables were presented no penalty was imposed. The column headings should have included 'temperature/°C' so that it was not necessary to repeat this information for each entry. This is one of the fundamental points in using a table to record a series of readings in an economic way.
- (ii)** Neat and accurate graphs were produced by many candidates. Points were generally clearly plotted and either joined in a smooth curve or by ruled connections. Both of these were acceptable but freehand attempts to join the points with straight lines were not. A small minority of candidates plotted with large, vague dots, so a sharper pencil would have been advantageous.
- (b) (i)** It was generally accepted that the temperature was similar to that of the human body but a few said it was room temperature.
- (ii)** Similarly, movement of the bottle was known to promote a more even distribution of temperature.
- (iii)** There were some rather unusual attempts to describe the avoidance of parallax. Perhaps the easiest way was found by those who said 'to read the scale at eye level'. There was some confusion when the idea of the line of vision being perpendicular to the thermometer was stated; many said parallel instead of perpendicular. Credit was given to the relatively small number who used the hand lens for an accurate reading.
- (c) (i)** The vast majority successfully completed the sentence using the words provided.
- (ii)** Most candidates drew the requisite line on the graph – a horizontal extension from the 37°C point on the y axis but in many it was unlabelled. This was accepted, however.

- (d) The design for the experiment was usually incomplete in that it did not follow the process to a logical conclusion. The idea of wetting the cloth and wrapping it round the beaker of hot water was usually described. Very few went on to read the temperature successively at stated intervals, possibly of one or five minutes. The experiment could then have been repeated using a dry cloth. These data might then have been tabulated and presented as graphs. Techniques such as using uniform volumes of water, starting with identical temperatures and replicating the whole sequence were possible additional scoring points. It was unusual for candidates to score more than half of the marks available in this section.

Question 2

- (a) & (b) The best answers were given by those candidates who realised that stomatal transpiration was the process under investigation. This was further modified by blocking the stomata with petroleum jelly.
- (a) (i) The condition of leaf A had to be recorded by means of a labelled drawing. The usual criteria of the drawing being a good size with clear, clean lines and adequate labelling were applied. The main shortcoming was poor, sometimes non-existent labelling. A fair proportion of candidates labelled stomata, which, surely, could not be seen. Any three labels were accepted from, for example, lamina, vein, mid-rib, margin, petiole (or leaf stalk).
- (ii) Most of the measurements given were realistic though a few did not tally with the units that were quoted. The line across the drawing was generally adequate and well ruled.
- (iii) The calculation of magnification was also well performed by the majority. Only a few candidates attempted to express their answer as a ratio or ruined their answer by adding units such as 'x 2.5 cm'. The amount of rounding the answer up or down was generally within the limit of a factor of ± 0.2 . And only a few quoted more than an acceptable two decimal places in the stated magnification. Practicality is the principal to bear in mind!
- (b) (i) Comparative answers were expected here. Thus, leaf B was more dry, shrivelled or wilted than leaf C and leaf D was relatively normal in appearance.
- (ii) Good answers here were, as already suggested, those that referred to transpiration and stomata, culminating in the relationship between the distribution of stomata mainly on the lower surface of the leaf and this being blocked by the layer of petroleum jelly.
- (c) (i) The cut surface of the stalk (celery) was frequently poorly drawn, especially because the stained veins were not well represented and only rarely indicated in the labelling. Three dimensional drawings were often attempted and excessive shading sometimes obscured the features.
- (ii) The majority of candidates realised that tissue similar to the stained tissue, i.e. xylem, would be found in the veins or mid-rib of a leaf such leaf A.
- (iii) Very creditable diagrams of a section of a root were drawn by many candidates. Others had little idea of what was required and drew root hairs or entire root systems which were not acceptable.

BIOLOGY

Paper 5090/06

Alternative to Practical

General comments

The Examiners tried, as usual, to reward evidence that candidates had performed, or at least witnessed, practical work. There were also the usual indications as to how carefully they had read and followed the rubric. This was especially evident in **Question 2 (a)** where there was an important distinction between features that were visible on the Figures and those whose presence was inferred – stomata, for example.

Skill in drawing a graph and familiarity with the determination of magnification were very productive in terms of marks. Conversely, in **Question 1 (d)**, experimental design, with practical details, was often incomplete.

The candidates obviously had plenty of time to complete the paper.

Comments on specific questions

Question 1

(a) (i) Many examples of well constructed, simple, yet fully labelled tables were seen. The column headings should have included 'temperature/°C' and 'time/minutes' so that it was not necessary to repeat this information for each entry. This is one of the fundamental points in using a table to record a series of readings in an economic way.

Common errors included not completely enclosing the boxes, drawing separate tables for the two experiments, including additional columns that were not required (e.g. change of temperature) and labelling the time in seconds rather than minutes.

(ii) Neat and accurate graphs were produced by many candidates. Points were generally clearly plotted and either joined in a smooth curve or by ruled connections. Both of these were acceptable but freehand attempts to join the points with straight lines were not. A small minority of candidates plotted with large, vague dots, so a sharper pencil would have been advantageous. Quite often only one of the curves was labelled. Reversed axes occurred very infrequently and bar charts were very scarce.

(iii) & (iv) The missing result was generally stated within the bounds 30 - 31°C and when a numerical answer, 6 C, was given for part **(iv)**, as was desirable, two easy marks were gained. Those who described heat transfer from the hotter to the cooler bodies of water scored well, especially if they went on to describe how the moving column of water in the tube took heat away from the container in Fig. 1.2. There was a great deal of confusion by those who described the insulatory properties of the plastic tubing.

(b) (i) It was generally accepted that the temperature was similar to that of the human body but a few said it was room temperature or an optimum temperature for enzyme activity.

(ii) Similarly, movement of the bottle was known to promote a more even distribution of temperature. The word 'constant' was mis-used for 'equal' in referring to temperature distribution by a significant minority of candidates.

(iii) There were some rather unusual attempts to describe the avoidance of parallax. Perhaps the easiest way was found by those who said 'to read the scale at eye level'. There was some confusion when the idea of the line of vision being perpendicular to the thermometer was stated; many said parallel instead of perpendicular. Credit was given to the relatively small number who used the hand lens for an accurate reading.

- (c) (i) Sweat and urine were the favoured answers
- (ii) Sweat was more easily explained in terms of evaporation with or without reference to latent heat. In many answers, anywhere in the question, all heat was referred to as 'latent'.
- (d) Answers to this section were generally short of practical instruction, not only in setting up the experiment but also in taking, recording and presenting results. The beaker of warm water might have been surrounded by the cloth, tied on with string and then had its temperature recorded at stated regular intervals. These readings could have been tabulated and presented in graph form. Use of the cloth, both wet and dry, was also possible as were replications of the processes. Many answers were spoilt by the inclusion of lengthy accounts of what, in theory, might have been expected to happen. This often included that the temperature of the water in the beaker would remain constant at 37°C.

Question 2

- (a) (i) There were many good drawings, but also many instances of them being completely unlabelled. No shading was necessary. Three realistic labels were expected, petiole (leaf stalk was allowed), lamina, vein and midrib were clear choices. Many labelled stomata, cuticle or xylem which were not visible.
- (ii) The instruction to draw a straight, therefore ruled, line across the drawing was not well carried out. Vertical lines showing the width, or commonly the length, were widely seen. Measurement and recording were usually clear, though there was some omission and confusion of units.
- (iii) The calculation appeared to be familiar to most candidates but a minority multiplied the expression $\times 100$ for no apparent reason. A few spoiled their answers by including cm. (' $\times 1.4$ cm'), and others were guilty of excessive rounding, for instance ' $\times 1.5 = \times 2$ ', or quoting more than two decimal places..
- (b) (i) Leaf B was best described as looking curled, dry, shrivelled, folded or wilted. What could not be determined was its colour. Leaf C could then be said to show the same feature but to a lesser extent and leaf D looked fresh, newly picked – or like leaf A, as many said.
- (ii) The key to this section was to relate the effect of transpiration to the distribution of stomata and the blocking of the stomata by the petroleum jelly.
- (c) (i) Diagrams were generally simple and adequately realistic. Some were not labelled and others claimed to show excessive detail like phloem, xylem and cambium within the bundles. Just a few candidates drew a theoretical section of a plant stem.
- (ii) Some, unsatisfactorily, gave xylem as the answer instead of vein or midrib, for instance.
- (iii) Many excellent drawings were seen and these were usually clearly related to the requirement of the question, but some did not satisfactorily clarify the roles of phloem and xylem in this context. Some drawings were of longitudinal aspects, or three-dimensional, while others drew a root hair.